Conceptual Cost Estimate for Sitewide Remedial Action, Omega Chemical Superfund Site

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Objective

As requested by the U.S. Environmental Protection Agency (EPA), this conceptual cost estimate was prepared to provide a rough indication of potential future response costs at the Omega Chemical Superfund Site, Whittier, California, in support of EPA's early *De Minimis* settlement (EPA, 1989, 1999a) negotiations with potentially responsible parties (PRPs). The intent of the settlement is to resolve liability under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) early in the response process, prior to the signature of the Record of Decision (ROD). A remedial investigation and feasibility study (RI/FS) for the site has not been completed. Thus, the conceptual cost estimate presented herein is based on assumptions regarding the nature and extent of contamination, and cost information from other sites, as recommended in EPA guidance (EPA, 1999a). The cost estimate presented herein is considered conceptual because the nature and extent of soil and groundwater contamination is currently unknown.

The approach to developing this conceptual cost estimate is described below. The scope of the future response actions includes RI, FS, remedial design (RD), remedial action (RA), operation and maintenance (O&M), oversight (OS), and other administrative costs. This conceptual cost estimate presented below is only for the RD, RA, and 30 years of O&M.

Approach

EPA guidance (EPA, 1999a) allows for two methods of estimating future costs:

1. Use response cost information from other sites with similar characteristics to arrive at a range of costs or an average cost. The cost may be adjusted based on site-specific factors if these are known.
2. Use the average unit cost of applicable treatment technologies and estimated extent of the contaminated media at the site.

The conceptual cost for groundwater remediation was prepared using unit rates (Method 2); the conceptual cost for soil remediation was prepared using costs from other sites (Method 1). The rationale for the approach is provided below.

Conceptual cost estimates for groundwater treatment were prepared using unit costs from other sites, assumed site conditions such as nature and extent of contamination (this estimate is based on site data collected through 2002), and an assumed remedial approach.

These estimated costs were compared to costs reported for other sites (EPA, 1999b, 2001a) as a validity check.

The conceptual cost estimate for soil treatment was prepared using historical cost information from sites with similar contaminants. Unit rates were not used because the volume of contaminated soil, contaminant concentrations, and number of contaminated areas is not known at this time (one area with soil contamination is known, but other areas likely exist at the site).

Site Background

A mixture of contaminants, including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, and inorganic compounds are present in soil and groundwater at the Omega site. The most pervasive contaminants in both soil and groundwater at the site include tetrachloroethene, trichloroethene, freons, and 1,4-dioxane. Also detected were other chlorinated hydrocarbons; aromatic hydrocarbons such as benzene, acetone, and toluene; and other compounds including hexavalent chromium and perchlorate. Other contaminants may be identified in the future.

Soil contamination occurs in vapor phase, sorbed to soil particles, and as nonaqueous liquid; contaminated soils extend over the former Omega Chemical Corporation property (approximately 250 feet by 300 feet) to an observed depth of at least 80 feet. The contamination dissolved in groundwater extends over an area at least 2.5 miles long and 0.75 mile wide; the contaminated aquifer zone is about 50 feet thick. The estimated volume of the contaminated water is, assuming aquifer porosity of 25 percent, about 4.9 billion (B) gallons. The estimated area where 1,4-dioxane has been found in previous investigations is a subset of the entire plume, approximately 5,500 feet long and 1,500 feet wide. Assuming the same aquifer thickness and porosity, the estimated volume of the 1,4-dioxane-contaminated groundwater is 771 million (M) gallons. The extent of contamination in both groundwater and soil is not accurately known at this time and is being addressed by an RI. There potentially may be more areas that require soil treatment than just the former Omega Chemical site. Investigation of these other sources of contamination is ongoing.

Presumptive Remedies

The assumed remedial methods for the site include extraction and treatment of contaminated groundwater, and in-situ treatment of the contaminated soil using soil vapor extraction (SVE); both are EPA Presumptive Remedies for VOCs. It is assumed that all contaminants present in groundwater and soil at the Omega site will be treated.

The pump and treat system likely will target portions of the aquifer separately. It is assumed that between 10 and 100 pore volume flushes will be needed to meet cleanup criteria (EPA, 1994). There are a number of highly contaminated portions of the shallow aquifer at the Omega site; these zones will require more focused remediation (e.g., more pore volume flushes) than the less contaminated parts of the shallow aquifer. The distribution of the contamination in the shallow aquifer at Omega is not known in detail and is the subject of an ongoing investigation. For cost-estimating purposes, it is assumed that a flow rate equal to an annual flush of 20 percent of the pore volume of the entire contaminated aquifer zone will be treated. A complex treatment train for groundwater may be required due to the mixture of known groundwater contaminants (e.g., chlorinated VOCs

and 1,4-dioxane). Based on what is currently known about the contaminants present in groundwater, the treatment train will include an advanced oxidation process (AOP) to remove 1,4-dioxane, and liquid-phase granular activated carbon (LGAC) to remove the VOCs not oxidized. Treatment for perchlorate would require either an ion exchange or biological treatment system (e.g., fluidized bed reactor).

It is assumed that a 3-year operation of the SVE system may suffice to meet soil cleanup criteria. Enhancement of the SVE system is likely to be required to remove 1,4-dioxane and also because of low-permeability soils. Thermally enhanced SVE (by resistive or radio frequency heating) is significantly more expensive than traditional SVE.

It is assumed that the RI/FS for the site will be completed in 2006, the remedial system will be designed and constructed between 2006 and 2008, the SVE system will operate from 2009 to 2011 (3 years), and the pump and treat system will operate between 2009 and 2038 (30 years). It is assumed that no capital and O&M costs occur during the RI/FS period, capital costs occur from 2006 to 2008, and O&M costs occur during the respective operating periods for the groundwater pump-and-treat and SVE systems.

Groundwater Pump and Treatment Conceptual Cost Estimate

The conceptual cost for the groundwater treatment system was prepared based on the assumptions discussed above and unit costs from similar sites (Attachments A-1 and A-2). Assumptions for the individual cost components are described below.

Assumed Groundwater Equipment Costs

This conceptual groundwater remediation cost estimate includes the wells, water conveyance pipeline to a treatment plant, a treatment plant, and pipelines to two discharge points. The estimated pipeline costs will vary depending on the final pipeline routing selected, conveyance distances involved, pipeline diameter (i.e., capacity), and the construction environment (e.g., number of road intersections, limitations due to existing underground utilities).

Assumed treatment plant equipment costs include major process unit costs, such as adsorbers and AOP reactors. Equipment costs also include auxiliary equipment costs, such as chemical (e.g., hydrogen peroxide) feed, storage, and monitoring systems. No cost for patent royalties is known to be required for the process evaluated; therefore, no royalty fees have been added. Most equipment costs are based on recent vendor estimates. However, where recent vendor estimates were not available, older estimates (1990 or later) were escalated by 3 percent per annum to account for inflation.

Conceptual Groundwater Construction Costs

Conceptual construction costs are factored based on a percentage of the total equipment cost. These factors are: site piping, site instrumentation and control (I&C), site electrical, and common facilities. The factors that account for site piping, site I&C, site electrical, and common facilities are derived from curves based on construction of wastewater treatment plants (EPRI, 1992). These curves vary the cost escalation factors based on the total equipment cost. For example, lower-cost systems have higher-percent cost factors to account for the ancillary needs.

Total Conceptual Capital Cost for Groundwater Remediation

Conceptual capital costs for the assumed groundwater remediation system include the sum of the construction costs and additional costs for engineering, overhead, and fees. The estimated cost for engineering, overhead, and fees also is derived from a curve based on construction of wastewater treatment plants (EPRI, 1992).

Land acquisition costs for a groundwater treatment plant are assumed to be $500,000. This estimate is based on an appraisal of properties in the immediate vicinity of the former Omega Chemical Corporation site (Nord, 2003).

Estimated Operations and Maintenance Costs for Groundwater Remediation

O&M costs include utilities (electricity, natural gas, water), carbon purchase and disposal, labor, chemical purchases, maintenance materials (assumed 2 percent of capital cost), and water and air sample analyses. For the purposes of this conceptual cost estimate, it is assumed that spent LGAC is transported offsite for reactivation by a service provider and that the cost of that service is "built into" the replacement cost of the carbon.

Comparison of Estimated Conceptual Costs to Actual Costs from Similar Sites

An accepted method to validate a preliminary cost estimate is to compare the estimated system cost to actual costs from similar systems. One resource of actual treatment system costs is an EPA cost analysis document (EPA, 2001a) that presents the system capital and O&M costs for 32 groundwater treatment systems.

A cost comparison is presented in Attachment A-3. The comparison shows that the CH2M HILL estimates for both capital and O&M costs are bracketed by the costs in the EPA (2001a) document. It is our opinion that the conceptual estimate developed by CH2M HILL is consistent with actual treatment system costs documented in the EPA (2001a) document.

Conceptual Soil Treatment Cost Estimate

The average historical, inflation-adjusted costs for soil treatment at other sites, as reported by EPA (EPA, 1999b) for SVE were used (Attachments B-1, B-2, and B-3). Limited site-specific information was available for sites with SVE systems, but all sites used different treatment technologies for VOCs. The SVE systems at the historical sites used between two and 129 extraction wells; it is expected that an SVE system at the Omega Chemical site will use a number of wells within this range.

Because the contaminant concentrations and volume of contaminated soil are not known, unit rates for SVE could not be used and the conceptual cost estimate could not be validated against historical cost data. The unit cost rates reported from historical sites decrease with the amount of soil treated (EPA, 2001b). Thermal enhancement, which may be required due to the presence of 1,4-dioxane, would increase the SVE treatment costs. The conceptual costs presented below do not include thermally enhanced SVE.

Escalation of Costs

The unit and historical costs, both in 2003 dollars, were escalated using a 2.5 percent per year escalation rate (Attachment C-1). This escalation rate was based on a 20-year average (1984 to 2003) of the Construction Cost Index found at http://enr.construction.com/features/conEco/costIndexes/constIndexHist.asp; a 10-year

average yielded the same rate. The historical estimates did not list the materials, services, and labor portions of O&M costs separately, and therefore a separate goods and services escalation index was not used to escalate labor costs. The unit cost estimates listed the O&M component costs separately; however, the labor component was small, approximately 18 percent, relative to the annual total. To maintain consistency, a goods and services escalator was not applied.

Discount Rates and Net Present Values

Two discount rates, 5.2 percent and 3.1 percent, were used to show a range of estimated net present values (Attachments C-2 and C-3 for 2003 payment, and C-4 and C-5 for 2004 payment). The higher discount rate was based on a 10-year average (1994 to 2003) of the nominal 3-year Treasury Bill (T-Bill) interest rates published by the Office of Management and Budget (OMB) in Circular A-94. The lower discount rate is the 2003 nominal 3-year T-Bill interest rate. The OMB Circular and supporting documents may be found at http://www.whitehouse.gov/omb/circulars/index.html.

The 3-year T-Bill rate was chosen for several reasons. It is based on what EPA can expect to earn from investing compensation collected from *de minimis* settlements, and T-Bills are a zero risk investment alternative. The 3-year T-Bill rates reflect a conservative estimate of the discount rate to mitigate uncertainty associated with assuming a rate over the 30-year course of the groundwater remediation component of this project. The 3-year maturity term allows for cash flow flexibility over the course of the project.

Estimated Net Present Value

The estimated 30-year net present value for the site RA conceptual costs are summarized in Tables 1 and 2, assuming end-of-year settlement payments in 2003 or 2004, respectively. The cost for land acquisition was added to the discounted capital and operation costs. The capital costs also include the costs for RD.

Table 1 - Conceptual Present Value in December 2003

Cost Item	Discount Rate	
	5.20%	3.10%
Capital - Groundwater Treatment	$23,500,000	$25,500,000
Capital - Soil Treatment	$2,100,000	$2,300,000
O&M - Groundwater Treatment	$48,400,000	$71,500,000
O&M - Soil Treatment	$1,400,000	$1,600,000
Land Acquisition	$500,000	$500,000
Total	$76,000,000	$101,400,000

Table 2 - Conceptual Present Value in December 2004

Cost Item	Discount Rate	
	5.20%	3.10%
Capital - Groundwater Treatment	$24,800,000	$26,300,000
Capital - Soil Treatment	$2,200,000	$2,400,000
O&M - Groundwater Treatment	$51,000,000	$73,700,000
O&M - Soil Treatment	$1,500,000	$1,700,000
Land Acquisition	$500,000	$500,000
Total	$79,900,000	$104,600,000

Limitations

The conceptual cost estimates prepared for the groundwater extraction and treatment for the Omega Site are based on gross assumptions regarding the nature and extent of contamination, and possible RA scenarios. The RI at the Omega site is ongoing; at the time this estimate was prepared, the FS had not yet been initiated. Thus, the actual remedial costs for the Omega site will be different than the estimate presented herein, possibly by more than an order of magnitude.

It is noted that offsite soil contamination related to the Omega Chemical site and requiring treatment may be found. Preliminary site information indicates that such offsite areas may exist. If this is the case, the cost for soil treatment (SVE) would increase.

The 30-year duration of the groundwater treatment system operation used for cost estimating purposes is typically used for FS-level cost estimates, but is somewhat arbitrary. Aquifer restoration may require much longer operation of the system. The operating costs would increase accordingly.

The conceptual capital cost, O&M cost, and net present value have been estimated. Capital costs are based on equipment size and quantity required to treat water with maximum contaminant levels observed in previous site investigations. O&M costs are based on treating water with "average" contaminant levels observed in previous investigations. There has been no effort made to account for the change of contaminant concentrations with time, or the potential for having to treat higher concentrations. As groundwater contaminant concentrations change, carbon usage rates, AOP chemicals, and power costs change.

The conceptual cost estimates shown, and any resulting conclusions on project financial or economic feasibility or funding requirements, have been prepared for guidance in project evaluation and implementation based on the information available at the time of the estimate. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. These other factors include, but are not limited to, target cleanup levels (and their potential changes in the future), emergent contaminants (i.e., new chemicals or chemicals that were previously not known to be toxic, the treatment of which would increase both the capital and operational costs), and inflation (the cost escalation factor and present value

discount rates used were based on historical cost data which are not guaranteed to provide a reliable forecast of future cost increases and investment returns).

As noted above, the final project costs will vary from the estimate presented herein, potentially by more than an order of magnitude. Because of these factors, project feasibility, benefit/cost ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

References

Electric Power and Research Institute (EPRI). 1992. *Wastewater Treatment Manual for Coal Gasification-Combined-Cycle Power Plants.* EPRI TR-101788.

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U.S. Environmental Protection Agency (EPA). 2001b. *Remediation Technology Cost Compendium – Year 2000.* EPA 542-R-01-009.

Attachment A-1

Materials List and Capital Cost Table

Fluidized Bed Anoxic Biological Treatment, Ferric Coprecipitation, UV Oxidation, Air Stripping, LGAC, Catalytic Peroxide Removal

Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

Major System	Component	Size	Material	Quantity	Unit Cost	Cost	Cost Estimate Source
Extraction Well System							
	Well	8-inch, 180 ft deep	Sand Pack/CS	20	$ 154,383	$ 3,087,662	Beylik Estimate, 2001
	Well Pump, VF Drive	70 gpm @ 300 ft H2O	CI/Bronze Trim	20	$ 32,654	$ 653,088	CH2M Files, Escalate from 2000
	Well Head Ancillary	Lot (Valves, Gauges)	CS/CI Fittings	20	$ 12,847	$ 256,933	CH2M Files, Escalate from 1998
Extracted Water Transmission Pipeline							
	Pipeline, Section 1	8-inch, Below grade	Poly	5000	$ 71	$ 355,554	CH2M Files, Escalate from 2000
	Pipeline, Section 2	12-inch, Below grade	Poly	5000	$ 91	$ 453,482	CH2M Files, Escalate from 2000
	Relief Valves/Pits		Brass	4	$ 6,078	$ 24,311	Means 1999
	Flow indicating totalizer	10-inch		1	$ 3,000	$ 3,000	CH2M Eng. Estimate
Exsitu Biological Anoxic Treatment System (Perchlorate removal)							
	Fluidized Bed Treatment System						
	-- Fluidize bed tanks	Size varies based on flow rate	CS, Epoxy coated	2	$ 1,181,137	$ 2,362,274	US Filter Quote, 2001
	-- Tank internals		CS/SS Trim		included		
	-- Biomass control unit				included		
	-- Fluidization pumps				included		
	-- Flow indicating totalizer	8-inch		2	$ 1,500	$ 3,000	CH2M Eng. Estimate
	-- Instruments and control Panel				included		
	-- Alcohol and nutrient feed pumps				included		
	Acetate/Alcohol Feed System						
	-- Slant bottom holding tank	10,000 gal	FRP	1	$ 16,469	$ 16,469	Ershigs Quote, 1993
	-- Tank level switch			1	$ 1,500	$ 1,500	Assumed
	-- Metering Pumps	10 gpm	Acid Spec			included above	US Filter Quote, 2001
	-- Pulsation dampener		Acid Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996
	Nutrient Feed System						
	-- Tote bin	250 gal	FRP			Vendor supplied	Ershigs Quote, 1993
	-- Tank level switch			1	$ 1,500	$ 1,500	Assumed
	-- Metering Pumps	up to 1 gpm	Acid Spec			included above	US Filter Quote, 2001
	-- Pulsation dampener		Acid Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996
pH Adjustment and Ferrous Feed (Hexavalent chromium removal)							
	Holding tank	20,000 gal	FRP	2	$ 24,448	$ 48,897	Ershigs Quote, 1993
	Tank level switch			2	$ 1,500	$ 3,000	Assumed
	Tank Mixer		Coated CI	2	$ 10,000	$ 20,000	Assumed
	Aeration system			2	$ 20,000	$ 40,000	Assumed
	pH Probe			2	$ 2,000	$ 4,000	Assumed
	Sulfuric Acid Feed System						

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Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

Major System	Component	Size	Material	Quantity	Unit Cost	Cost	Cost Estimate Source
	-- Slant bottom holding tank	10,000 gal	FRP	1	$ 16,469	$ 16,469	Ershigs Quote, 1993
	-- Tank level switch			1	$ 1,500	$ 1,500	Assumed
	-- Metering Pumps	10 gpm	Acid Spec	2	$ 8,332	$ 16,665	CH2M Estimate
	-- Pulsation dampener		Acid Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996
	Ferrous Chloride Feed System						
	-- Slant bottom holding tank	10,000 gal	FRP	1	$ 16,469	$ 16,469	Ershigs Quote, 1993
	-- Tank level switch			1	$ 1,500	$ 1,500	Assumed
	-- Metering Pumps	10 gpm	Acid Spec	2	$ 8,332	$ 16,665	CH2M Estimate
	-- Pulsation dampener		Acid Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996
Pump Station							
	Holding tank	20,000 gal	FRP	1	$ 24,448	$ 24,448	Ershigs Quote, 1993
	Tank level switch			1	$ 1,500	$ 1,500	Assumed
	Transfer pumps	2000 gpm @ 150 ft H2O	CI/SS trim	2	$ 25,128	$ 50,256	Gierlich-Mitchell Quote, escalate from 1998
Multimedia Filter System							
	Multimedia filter vessels and media	1000 gpm	CS, Epoxy coated	4	$ 160,709	$ 642,836	Yardney, Escalate from 2000
	Differential pressure switch	0 - 30 psig	Brass	1		included above	
UV Oxidation System (for 1,4 Dioxane and 95+% of unsaturated VOCs)							
	AOP System (1,900 gpm, 100 kW)						
	-- ASME Code vessels		CS	1	$ 368,703	$ 368,703	Trojan Quote, 2003
	-- UV Light System		Quartz/SS/Teflon		included		
	-- Piping inside AOP system		SS		included		
	-- Graphic Control Panel;				included		
	Peroxide Feed System						
	-- Holding Tank	10,000 gal	FRP	1	$ 21,959	$ 21,959	Ershigs Quote, 1993
	-- Tank level switch			1	$ 500	$ 500	Assumed
	-- Metering Pumps	0.5 gpm	Acid Spec	2	$ 7,010	$ 14,021	CH2M Files, escalate from 1996
	-- Pulsation dampener		Acid Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996
pH Adjustment and Caustic Feed							
	Static Mixer			1	$ 10,000	$ 10,000	Assumed
	pH Probe			1	$ 2,000	$ 2,000	Assumed
	Caustic Feed System						
	-- Slant bottom holding tank	10,000 gal	FRP	1	$ 16,469	$ 16,469	Ershigs Quote, 1993
	-- Tank level switch			1	$ 1,500	$ 1,500	Assumed
	-- Metering Pumps	10 gpm	Caustic Spec	2	$ 8,332	$ 16,665	CH2M Estimate
	-- Pulsation dampener		Caustic Spec	1	$ 615	$ 615	CH2M Files, escalate from 1996

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Fluidized Bed Anoxic Biological Treatment, Ferric Coprecipitation, UV Oxidation, Air Stripping, LGAC, Catalytic Peroxide Removal

Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

Major System	Component	Size	Material	Quantity	Unit Cost	Cost	Cost Estimate Source
Air Stripper (for Strippable and saturated VOCs)							
	Stripper Tower	2000 gpm (10'diameter)	FRP	1	$ 250,000	$ 250,000	Assumed
	Inlet Blower	10000 scfm		1	$ 15,000	$ 15,000	Assumed
	Off-Gas Blower	10000 scfm		1	$ 15,000	$ 15,000	Assumed
	Off-Gas Heater	10000 scfm @ 20F		1	$ 10,000	$ 10,000	Assumed
	Off-Gas Vapor Phase GAC	10,000 # GAC	CS	3	$ 70,000	$ 210,000	Assumed
Pump Station							
	Holding tank	Not required - Use Stripper Basin					
	Tank level switch			1	$ 1,500	$ 1,500	Assumed
	Transfer pumps	2000 gpm @ 150 ft H2O	CI/SS trim	2	$ 25,128	$ 50,256	Gierlich-Mitchell Quote, escalate from 1998
LGAC Adsorber System (for Any Remaining Trace VOCs)							
	LGAC adsorber columns (1 pair)	20,000 lbs, 120"Dia x 144"SS each	CS, Epoxy coated	4	$ 139,050	$ 556,200	Vendor Quote (Calgon, 2002)
	Differential Pressure Switch	0-30 psig	Brass	4	$ 515	$ 2,059	McMaster-Carr
	Flow indicating totalizer	10-inch		1	$ 3,000	$ 3,000	CH2M Eng. Estimate
Catalytic Peroxide Removal System							
	Catalyst columns (1 pair)	20,000 lbs, 120"Dia x 144"SS each	CS, Epoxy coated	2	$ 199,050	$ 398,100	Vendor Quote (Calgon, 2003)
	Differential Pressure Switch	0-30 psig	Brass	1	$ 515	$ 515	McMaster-Carr
Backwash and Rinse Recovery System							
	BW and Rinse Recovery						
	-- Cone bottom holding tank	20,000 gal	FRP	2	$ 33,234	$ 66,469	Ershigs Quote, 1993
	-- VGAC Drum			2	$ 300	$ 600	CH2M Eng. Estimate
	-- Diaphragm-type sludge pump			3	$ 2,000	$ 6,000	CH2M Eng. Estimate
	-- Polymer tank with mixer	50 gal	SS	1	$ 3,845	$ 3,845	McMaster-Carr (P.1248, 1257), 2001
	-- Polymer feed pump	10 gph	316 SS	3	$ 7,437	$ 22,312	CH2M Files - Escalate from 1994
	-- Backwash recirculation pump	200 gpm @ 30'	CS, SS Impeller	2	$ 3,499	$ 6,997	CH2M Files - Escalate from 1993
	-- Plate and frame filter press	25 cu.ft.	PVC	2	$ 121,740	$ 243,479	Vendor Quote (US Filter, 2002) - Adjusted for size
	-- Tank level switch			2	$ 1,500	$ 3,000	Assumed
Treated Water Transmission Pipeline							
	Pipeline	12-inch, Below grade	Poly	1000	$ 85	$ 85,490	CH2M Files, Escalate from 2000
	Relief Valves/Pits		Brass	1	$ 5,400	$ 5,400	Means 1999
	SubTotal "A"					$ 10,533,703	

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Materials List and Capital Cost Table

Fluidized Bed Anoxic Biological Treatment, Ferric Coprecipitation, UV Oxidation, Air Stripping, LGAC, Catalytic Peroxide Removal

Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

Major System	Component	Size	Material	Quantity	Unit Cost	Cost	Cost Estimate Source
	Site Piping			7.2%	of SubTotal "A"	$ 753,584	1992 EPRI Document (Note 3), Figure 7-1
	Site I & C			4.2%	of SubTotal "A"	$ 444,709	1992 EPRI Document, Figure 7-2
	Site Electrical			4.7%	of SubTotal "A"	$ 499,909	1992 EPRI Document, Figure 7-3 (Note 4)
	Common Facilities			12.3%	of SubTotal "A"	$ 1,298,873	1992 EPRI Document, Figure 7-4
	Building/Lab Site Improvements			5.0%	of SubTotal "A"	$ 526,685	
	SubTotal "B"					$ 14,057,464	
	"Pass through" materials - None					$ -	
	SubTotal "C"					$ 14,057,464	
	Engineering, Overhead, Fees			32.8%	of SubTotal "C"	$ 4,608,233	1992 EPRI Document, Figure 7-5
	SubTotal "D"					$ 18,666,000	
	Cost Basis Contingency			20.0%	of SubTotal "C"	$ 3,733,200	
	Concept Scope Contingency			20.0%	of SubTotal "C"	$ 3,733,200	
	GRAND TOTAL					$ 26,130,000	

NOTES:
1. All cost escalation adjustments assumed 3% inflation per year.
2. All equipment cost adjustments for size based on the formula: Adjusted Cost = Orig. Cost * (Adjusted Size/Orig. Size) EXP X where "X" is 0.33 for pumps, 0.57 for Tanks, 0.62 for towers, and 0.6 for other process equipment.
3. The 1992 EPRI document is EPRI document EPRI TR-101788, Dec 1992.
4. Site Electrical factor is escalated by 20 percent to account for use of 220 and 440 VAC service.

Attachment A-2

Operations and Maintenance Cost Table

Fluidized Bed Anoxic Biological Treatment, Ferric Coprecipitation, UV Oxidation, Air Stripping, LGAC, Catalytic Peroxide Removal Concept

Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

O&M Catagory	Equip. Name	Equip. Description	O&M Requirm't per Unit	Number of Units	Total Requirements	Units	Unit Cost	Cost
Electrical Power								
	Well Pumps	1900 gpm @ 300'	1,166,274	1	1,166,274	kW-hr		
	Bioreactor-Fluidiz. Pumps	10 hp each	81,892	4	327,567	kW-hr		
	Bioreactor-Biomass Pumps	2 hp each	16,378	2	32,757	kW-hr		
	Bioreactor-Pump Stn	1900 gpm @ 150'	583,137	1	583,137	kW-hr		
	Ethanol metering pumps	1 hp each	8,189	2	16,378	kW-hr		
	Nutrient metering pumps	0.5 hp each	4,095	2	8,189	kW-hr		
	UV/Ox Reactor	100 kW	922,105	1	922,105	kW-hr		
	Peroxide metering pumps	1 hp each	8,189	2	16,378	kW-hr		
	Ferric metering pumps	1 hp each	8,189	2	16,378	kW-hr		
	Acid metering pumps	1 hp each	8,189	2	16,378	kW-hr		
	Caustic metering pumps	1 hp each	8,189	2	16,378	kW-hr		
	Air Stripper Pump Stn	1900 gpm @ 150'	583,137	1	583,137	kW-hr		
	Air Stripper Blower	50 hp each	409,459	1	409,459	kW-hr		
	Polymer metering pumps	0.5 hp each, 50% time	2,047	1	2,047	kW-hr		
	Polymer Tank Mixer	1 hp, 10% time	205	1	205	kW-hr		
	Backwash Tank Pump	200 gpm @ 30', 10% time	311	1	311	kW-hr		
	Misc. Controls/Lights	1,500 W	16,466	1	16,466	kW-hr		
	Total				4,133,545	kW-hr	$ 0.12	$ 496,025
Carbon Make-up								
	LGAC	1000 lbs/day	365,000	1	365,000	lbs C	$ 0.50	$ 182,500
	Bioreactor LGAC (Use waste adsorber LGAC)							
	VGAC	300 lbs/day	109,500	1	109,500	lbs C	$ 1.10	$ 120,450
	Peroxide Catalyst	every 5 years	8,000	2	16,000	lbs C	$ 2.00	$ 32,000
Chemicals/Materials								
	Hydrogen Peroxide	40 ppm dosage	333,146	1	333,146	lbs dry	$ 1.00	$ 333,146
	Ferric Chloride	15 ppm dosage	124,930	1	124,930	lbs dry	$ 0.15	$ 18,739
	Acetic Acid	20 ppm dosage	19,973	1	19,973	gal	$ 1.50	$ 29,959
	Phos Acid/Urea	2.5 ppm dosage	20,822	1	20,822	lbs	$ 0.25	$ 5,205
	Sulfuric Acid	250 ppm dosage	2,082,164	1	2,082,164	lbs	$ 0.05	$ 104,108
	Caustic	200 ppm dosage	1,665,732	1	1,665,732	lbs	$ 0.11	$ 183,230
	Polymer - Floc	1 ppm dosage	8,329	1	8,329	lbs dry	$ 3.00	$ 24,986
	Polymer - Dewatering	20 lbs/dry ton	1,666	1	1,666	lbs	$ 3.00	$ 4,997
Residuals Disposal								
	LGAC	Included above						

Attachment A-2

Operations and Maintenance Cost Table

Fluidized Bed Anoxic Biological Treatment, Ferric Coprecipitation, UV Oxidation, Air Stripping, LGAC, Catalytic Peroxide Removal Concept

Site-Wide RA Cost Estimate

Omega Chemical Superfund Site, CA

O&M Catagory	Equip. Name	Equip. Description	O&M Requirm't per Unit	Number of Units	Total Requirements	Units	Unit Cost	Cost
	VGAC	Included above						
	LGAC backwash sludge	Included with bioreactor sludge						
	Bioreactor sludge	20 ppm @ 30% solids	278	1	278	tons	$ 60.00	$ 16,657
Analytical								
	Water Samples			72		ea.	$ 400.00	$ 28,800
	Air Samples			36		ea.	$ 250.00	$ 9,000
	Monitoring Wells			20		ea.	$ 1,740.00	$ 34,800
Labor								
	Operating			10400		hrs	$ 30.00	$ 312,000
	Maintenance			2080		hrs	$ 34.50	$ 71,760
	Supvisory			2080		hrs	$ 40.50	$ 84,240
	Clerical			520		hrs	$ 19.50	$ 10,140
	Laboratory			0		hrs	$ 30.00	$ -
	Yardwork			0		hrs	$ 30.00	$ -
Subcontracts								
	Monitoring Wells Sampling (Subcontract)			1		lot	$ 100,000.00	$ 100,000
	Regulatory Monitoring reports (RWCQB, EPA, Air Emissions Inventory)			1		lot	$ 25,000.00	$ 25,000
Parts	(2% of Capital)				1.5%		$ 14,057,464	$ 210,862
								$ 2,439,000
Contingency on Materials/Services					10%			$ 243,900
		GRAND TOTAL						$ 2,682,900

Attachment A-3
Comparison of Estimated Conceptual Costs to Actual Costs from Similar Sites
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

The CH2M HILL conceptual cost estimate for the groundwater treatment system is compared to actual treatment system costs reported in an EPA–013 Document (EPA, 2001a). The EPA–013 document presents the system capital and O&M costs for 32 groundwater treatment systems.

The mixture of contaminants at the Omega Chemical site will require a system consisting of more treatment technologies than most of the sites cited in EPA-013. As a result, the estimated capital cost is unusually high for a typical system with a total system flowrate of 1900 gpm. Most groundwater treatment systems use only one or two treatment technologies.

To allow comparison, a separate estimate was prepared to just include VOC treatment (air stripping followed by liquid phase granular activated carbon [LPGAC]) so that it is comparable to site data in the EPA–013 document. This system is for comparison only, it is not intended to represent the cost of a system to treat 1,4-dioxane nor freons.

The estimated costs for a system designed to treat only VOCs, excluding 1,4-dioxane and freons, are:

Capital Cost:	$17,330,000 (2003 Dollars)
Annual O&M Cost:	$ 1,612,000 (2003 Dollars)
Annual Flow:	998,640,000 gallons

Exhibit 3 of the EPA–013 document is a table summarizing VOC treatment costs for 32 groundwater VOC treatment systems, including a column of average values. The reported average values are:

Capital Cost:	$ 4,900,000 (1999 Dollars)
Annual O&M Cost:	$ 770,000 (1999 Dollars)
Annual Flow:	120,000,000 gallons

The EPA –013 document costs must be adjusted to account for flowrate and year of construction in order to be comparable to the CH2M HILL values. Capital costs for process systems can be adjusted for the difference in flow rate by the formula below

(Peters and Timmerhaus, Plant Design and Economics for Chemical Engineers, 3rd Edition, McGraw Hill):

Capital @ Flow 2 = Capital @ Flow 1 * (Flow 2/Flow 1)^0.6

Substituting the values above yields:

Capital @ 999 Mgal/yr = $4,900,000 * (999/120)^0.6

Capital @ 999 Mgal/yr = $17,500,000

Furthermore, the flow adjusted cost must be escalated. The construction cost indexes (see Escalation of Costs below) for 1999 and 2003 are:

ENR Construction Cost Factor for 1999: 6059

ENR Construction Cost Factor for 2003: 6689

The construction cost in 2003 is estimated using the following formula:

Capital @ Year 2 = Capital @ Year 1 * (Cost Factor, Year 2/Cost Factor, Year 1)

Substituting the values above yields:

Capital @ 2003 = $17,500,000 * (6689/6059) = $19,300,000

Comparing the EPA -013 document cost after adjusting for flowrate and year of construction to the CH2M HILL developed cost for treating VOCs only ($17,300,000) indicates that the CH2M HILL estimate is about 9 percent lower.

The EPA -013 document O&M costs must also be adjusted for flowrate and year of operation to be comparable to the CH2M HILL estimates. However, for O&M costs, large systems can have a much lower O&M cost (per 1,000 gallons treated) because the management and general facilities costs are spread across a much larger volume.

Exhibit 9 of the EPA -013 document summarizes O&M cost data from the 32 sites and illustrates that the O&M costs drop considerably with higher total system flow rates. Since the Omega site system will treat about 999,000,000 gallons per year, which is off to the right end of the Exhibit 9 graph, use of the low end of the O&M cost range is indicated. Exhibit 5 further refines the classification of those sites into operating technologies and contaminants. Based on the values in Exhibit 5, for an initial comparison, we select the lowest 25 percentile O&M cost ($2.00/1,000gal in 1999 Dollars) for air stripping and GAC treatment.

Total Annual O&M Cost = $2.00/kGal * 999,000 kGal/yr= $1,998,000

Adjusting for inflation since 1999:

O&M @ 2003 = $1,998,000 * (6689/6059) = $2,206,000

Comparing the lowest 25 percentile O&M cost ($2.00/1,000gal) for air stripping and GAC treatment from the EPA -013 document, after adjusting for flowrate and year of construction, to the CH2M HILL developed cost for treating VOCs only ($1,612,000) indicates that the CH2M HILL cost are about 27 percent lower.

Another basis for comparison is to select specific sites from the EPA -013 document that are more comparable to the total annual flow rate anticipated for the Omega Site. Below are data from the two largest sites in the EPA -013 document:

Site Name	Annual Flow (kGal/yr)	Annual O&M Cost ($/kGal)
Twin Cities Army Ammo Plant	1,400,000	$0.58
Des Moines, IA	550,000	$0.25

The average cost for these two largest sites is $0.42 /1,000gal. Based on the flow rate for the Omega Site and adjusting for inflation, the annual O&M cost would be about $450,000, which is about 70 percent below the CH2M HILL estimate.

The CH2M HILL conceptual O&M estimate is above the cost predicted based on the two largest sites in the EPA -103 document and below the cost predicted based the lowest 25 percentile (i.e., larger sites) for air stripping and GAC treatment systems. Thus, the CH2M HILL O&M estimate is bracketed by the costs in the EPA -013 document.

In summary, it is our opinion that the conceptual estimate developed by CH2M HILL is consistent with actual treatment system costs documented in the EPA-013 document.

Attachment B-1
Historical Costs
Site Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

	Actual Cost				Adjusted 2003 Cost		
Pump & Treat Systems	Capital	Year	O&M	Year	Capital	O&M	gal/year
Firestone, CA	$4,133,543	1986	$1,250,181	1989	$6,437,548	$1,812,018	178,597,347
McClellan AFB, CA	$4,000,000	1995	$1,240,000	1995	$4,890,514	$1,516,059	131,400,000
Twin Cities AMP, MN	$8,034,454	1995	$588,599	1995	$9,823,152	$719,638	1,524,240,000
US DOE Svannah River, SC	$4,103,000	1995	$149,200	1995	$5,016,444	$182,416	268,056,000
Garden State Cleaners, NJ	$1,951,000	1991	$249,000	1991	$2,699,119	$344,480	525,600,000
Lockheed, Burbank, CA	$4,300,000	1994	$630,000	1994	$5,318,547	$779,229	525,600,000
Average					$5,697,554	$892,307	525,582,224
Expected volume treated annually							987,148,950
1,4-dioxane treatment (for 1,500 gpm)					$598,750	$107,993	788,400,000
(quotes for capital and O&M; $0.14/1,000gal)							
Total 2003					$6,296,304	$1,000,299	

	Actual Cost				Adjusted 2003 Cost	
SVE Systems	Capital	Year	O&M	Year	Capital	O&M
Twin Cities Army Ammunition Plant, MN	$4,300,000	1992	$500,000	1992	$5,769,850	$670,913
Commencement Bay, WA	$5,313,973	1995	$100,000	1994	$6,497,014	$123,687
Fairchild Semiconductor Crop., CA	$2,100,000	1995	$1,800,000	1995	$2,567,520	$2,200,731
Luke AFB, AZ	$297,017	1995	$210,168	1992	$363,141	$282,009
Sacramento Army Depot, CA	$556,000	1993	$290,000	1993	$713,836	$372,324
Hill AFB, UT	$335,000	1995	$132,000	1995	$409,581	$161,387
Amcor Precast, UT	$156,950	1995	$62,750	1992	$191,892	$84,200
Total 2003 (average adjusted cost)					$2,358,976	$556,464

Projected Total Cost	Annual Escalation	Years of Operation	Years of Construction	Capital	O&M
Pump&Treat	2.5%	2009-2038	2006-2008	$6,956,300	$51,189,726
SVE	2.5%	2009-2011	2006-2008	$2,606,251	$1,987,974
Total				$9,562,551	$53,177,700

Attachment B-2
Escallation of Scaled Average Historical Costs
Site Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

	year	P&T O&M cost	P&T capital cost	SVE O&M cost	SVE capital cost	Annual Rate
RI/FS	2003	$1,000,299	$6,296,304	556464.3782	$2,358,976	1.02523438
	2004	$1,025,541	$6,455,187	$570,506	$2,418,503	
	2005	$1,051,420	$6,618,080	$584,903	$2,479,533	
CONSTRUCTION	2006	$1,077,952	$6,785,083	$599,662	$2,542,102	
	2007	$1,105,153	$6,956,300	$614,795	$2,606,251	
	2008	$1,133,041		$630,309		
O&M	2009	$1,161,633		$646,214		
	2010	$1,190,946		$662,521		
	2011	$1,220,999		$679,239		
	2012	$1,251,810				
	2013	$1,283,399				
	2014	$1,315,784				
	2015	$1,348,987				
	2016	$1,383,028				
	2017	$1,417,928				
	2018	$1,453,709				
	2019	$1,490,392				
	2020	$1,528,001				
	2021	$1,566,559				
	2022	$1,606,090				
	2023	$1,646,619				
	2024	$1,688,171				
	2025	$1,730,770				
	2026	$1,774,445				
	2027	$1,819,222				
	2028	$1,865,129				
	2029	$1,912,195				
	2030	$1,960,448				
	2031	$2,009,919				
	2032	$2,060,638				
	2033	$2,112,636				
	2034	$2,165,948				
	2035	$2,220,604				
	2036	$2,276,639				
	2037	$2,334,089				
	2038	$2,392,988				
Sum Escalated Cost		$51,189,726		$1,987,974		

Attachment B-3
Construction Cost Index
Site Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

year	cost	(base = 1913 cost)
1908	97	
1909	91	-6.2%
1910	96	5.5%
1911	93	-3.1%
1912	91	-2.2%
1913	100	9.9%
1914	89	-11.0%
1915	93	4.5%
1916	130	39.8%
1917	181	39.2%
1918	189	4.4%
1919	198	4.8%
1920	251	26.8%
1921	202	-19.5%
1922	174	-13.9%
1923	214	23.0%
1924	215	0.5%
1925	207	-3.7%
1926	208	0.5%
1927	206	-1.0%
1928	207	0.5%
1929	207	0.0%
1930	203	-1.9%
1931	181	-10.8%
1932	157	-13.3%
1933	170	8.3%
1934	198	16.5%
1935	196	-1.0%
1936	206	5.1%
1937	235	14.1%
1938	236	0.4%
1939	236	0.0%
1940	242	2.5%
1941	258	6.6%
1942	276	7.0%
1943	290	5.1%
1944	299	3.1%
1945	308	3.0%
1946	346	12.3%
1947	413	19.4%
1948	461	11.6%
1949	477	3.5%
1950	510	6.9%

Attachment B-3
Construction Cost Index
Site Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

1951	543	6.5%
1952	569	4.8%
1953	600	5.4%
1954	628	4.7%
1955	660	5.1%
1956	692	4.8%
1957	724	4.6%
1958	759	4.8%
1959	797	5.0%
1960	824	3.4%
1961	847	2.8%
1962	872	3.0%
1963	901	3.3%
1964	936	3.9%
1965	971	3.7%
1966	1019	4.9%
1967	1074	5.4%
1968	1155	7.5%
1969	1269	9.9%
1970	1381	8.8%
1971	1581	14.5%
1972	1753	10.9%
1973	1895	8.1%
1974	2020	6.6%
1975	2212	9.5%
1976	2401	8.5%
1977	2576	7.3%
1978	2776	7.8%
1979	3003	8.2%
1980	3237	7.8%
1981	3535	9.2%
1982	3825	8.2%
1983	4066	6.3%
1984	4146	2.0%
1985	4195	1.2%
1986	4295	2.4%
1987	4406	2.6%
1988	4519	2.6%
1989	4615	2.1%
1990	4732	2.5%
1991	4835	2.2%
1992	4985	3.1%
1993	5210	4.5%
1994	5408	3.8%
1995	5471	1.2%

Attachment B-3
Construction Cost Index
Site Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

1996	5620	2.7%
1997	5826	3.7%
1998	5920	1.6%
1999	6059	2.3%
2000	6221	2.7%
2001	6343	2.0%
2002	6538	3.1%
2003	6689	2.3%
20-year average		2.5%

Attachment C-1
Escalation of Unit O&M Costs using the Escalation Rate Applied to the Historical Estimates (2.5%)
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

Year	Escalated Annual O&M Costs	Escalated Capital Costs	Annual Escalation Rate
2003	$2,682,900	$26,130,000	1.025
2004	$2,749,973	$26,783,250	
2005	$2,818,722	$27,452,831	
2006	$2,889,190	$28,139,152	
2007	$2,961,420	$28,842,631	
2008	$3,035,455	$29,563,697	
2009	$3,111,341		
2010	$3,189,125		
2011	$3,268,853		
2012	$3,350,574		
2013	$3,434,339		
2014	$3,520,197		
2015	$3,608,202		
2016	$3,698,407		
2017	$3,790,867		
2018	$3,885,639		
2019	$3,982,780		
2020	$4,082,350		
2021	$4,184,408		
2022	$4,289,019		
2023	$4,396,244		
2024	$4,506,150		
2025	$4,618,804		
2026	$4,734,274		
2027	$4,852,631		
2028	$4,973,947		
2029	$5,098,295		
2030	$5,225,753		
2031	$5,356,396		
2032	$5,490,306		
2033	$5,627,564		
2034	$5,768,253		
2035	$5,912,459		
2036	$6,060,271		
2037	$6,211,778		
2038	$6,367,072		

Attachment C-2
Present Value of Unit Estimates for Pump and Treat Systems Design
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

Year	Land Costs	Escalated Capital Cost	Escalated O&M cost	Total Annual Outlays (B+C+D)	Discounting Period	Present Value (Discount Rate=5.2%)	Present Value (Discount Rate=3.1%)
2003	$0	$0	$0	$0	0	$0	$0
2004		$0	$0	$0	1	$0	$0
2005		$0	$0	$0	2	$0	$0
2006		$0	$0	$0	3	$0	$0
2007		$28,842,631	$0	$28,842,631	4	$23,548,970	$25,527,025
2008			$0	$0	5	$0	$0
2009			$3,111,341	$3,111,341	6	$2,295,373	$2,590,572
2010			$3,189,125	$3,189,125	7	$2,236,461	$2,575,496
2011			$3,268,853	$3,268,853	8	$2,179,062	$2,560,508
2012			$3,350,574	$3,350,574	9	$2,123,135	$2,545,607
2013			$3,434,339	$3,434,339	10	$2,068,644	$2,530,792
2014			$3,520,197	$3,520,197	11	$2,015,551	$2,516,064
2015			$3,608,202	$3,608,202	12	$1,963,821	$2,501,422
2016			$3,698,407	$3,698,407	13	$1,913,419	$2,486,864
2017			$3,790,867	$3,790,867	14	$1,864,310	$2,472,392
2018			$3,885,639	$3,885,639	15	$1,816,462	$2,458,003
2019			$3,982,780	$3,982,780	16	$1,769,842	$2,443,699
2020			$4,082,350	$4,082,350	17	$1,724,418	$2,429,478
2021			$4,184,408	$4,184,408	18	$1,680,160	$2,415,339
2022			$4,289,019	$4,289,019	19	$1,637,038	$2,401,283
2023			$4,396,244	$4,396,244	20	$1,595,023	$2,387,308
2024			$4,506,150	$4,506,150	21	$1,554,086	$2,373,415
2025			$4,618,804	$4,618,804	22	$1,514,200	$2,359,603
2026			$4,734,274	$4,734,274	23	$1,475,337	$2,345,871
2027			$4,852,631	$4,852,631	24	$1,437,472	$2,332,219
2028			$4,973,947	$4,973,947	25	$1,400,579	$2,318,646
2029			$5,098,295	$5,098,295	26	$1,364,633	$2,305,153
2030			$5,225,753	$5,225,753	27	$1,329,609	$2,291,738
2031			$5,356,396	$5,356,396	28	$1,295,484	$2,278,401
2032			$5,490,306	$5,490,306	29	$1,262,235	$2,265,141
2033			$5,627,564	$5,627,564	30	$1,229,839	$2,251,959
2034			$5,768,253	$5,768,253	31	$1,198,275	$2,238,854
2035			$5,912,459	$5,912,459	32	$1,167,520	$2,225,824
2036			$6,060,271	$6,060,271	33	$1,137,556	$2,212,871
2037			$6,211,778	$6,211,778	34	$1,108,360	$2,199,993
2038			$6,367,072	$6,367,072	35	$1,079,913	$2,187,190
Total	$0	$28,842,631	$136,596,301	$165,438,932		$71,986,789	$97,028,728

Attachment C-3
Present Value of Soil Vapor Extraction Systems Based on Average Escalated Historical Costs
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

Year	Land Costs	Escalated Capital Cost	Escalated O&M cost	Total Annual Outlays (B+C+D)	Discounting Period	Present Value (Discount Rate=5.2%)	Present Value (Discount Rate=3.1%)
2003	$0	$0	$0	$0	0	$0	$0
2004		$0	$0	$0	1	$0	$0
2005		$0	$0	$0	2	$0	$0
2006		$0	$0	$0	3	$0	$0
2007		$2,606,251	$0	$2,606,251	4	$2,127,910	$2,306,649
2008			$0	$0	5	$0	$0
2009			$646,214	$646,214	6	$476,740	$538,052
2010			$662,521	$662,521	7	$464,611	$535,043
2011			$679,239	$679,239	8	$452,790	$532,051
Total	$0	$2,606,251	$1,987,974	$4,594,224		$3,522,051	$3,911,795

Discount Rates:
1994 to 2003 3-year T-Bill Average
0.052
2003 3-year T-Bill Rate
0.031

Attachment C-4
Present Value of Unit Estimates for Pump and Treat Systems Design
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

Year	Land Costs	Escalated Capital Cost	Escalated O&M cost	Total Annual Outlays (B+C+D)	Discounting Period	Present Value (Discount Rate=5.2%)	Present Value (Discount Rate=3.1%)
2003	$0	$0	$0	$0	0	$0	$0
2004		$0	$0	$0	0	$0	$0
2005		$0	$0	$0	1	$0	$0
2006		$0	$0	$0	2	$0	$0
2007		$28,842,631	$0	$28,842,631	3	$24,773,516	$26,318,363
2008			$0	$0	4	$0	$0
2009			$3,111,341	$3,111,341	5	$2,414,732	$2,670,880
2010			$3,189,125	$3,189,125	6	$2,352,757	$2,655,336
2011			$3,268,853	$3,268,853	7	$2,292,373	$2,639,883
2012			$3,350,574	$3,350,574	8	$2,233,538	$2,624,520
2013			$3,434,339	$3,434,339	9	$2,176,213	$2,609,247
2014			$3,520,197	$3,520,197	10	$2,120,360	$2,594,062
2015			$3,608,202	$3,608,202	11	$2,065,940	$2,578,966
2016			$3,698,407	$3,698,407	12	$2,012,917	$2,563,957
2017			$3,790,867	$3,790,867	13	$1,961,255	$2,549,036
2018			$3,885,639	$3,885,639	14	$1,910,918	$2,534,202
2019			$3,982,780	$3,982,780	15	$1,861,874	$2,519,454
2020			$4,082,350	$4,082,350	16	$1,814,088	$2,504,791
2021			$4,184,408	$4,184,408	17	$1,767,529	$2,490,214
2022			$4,289,019	$4,289,019	18	$1,722,164	$2,475,722
2023			$4,396,244	$4,396,244	19	$1,677,964	$2,461,315
2024			$4,506,150	$4,506,150	20	$1,634,899	$2,446,991
2025			$4,618,804	$4,618,804	21	$1,592,938	$2,432,750
2026			$4,734,274	$4,734,274	22	$1,552,055	$2,418,593
2027			$4,852,631	$4,852,631	23	$1,512,221	$2,404,518
2028			$4,973,947	$4,973,947	24	$1,473,409	$2,390,524
2029			$5,098,295	$5,098,295	25	$1,435,594	$2,376,612
2030			$5,225,753	$5,225,753	26	$1,398,748	$2,362,781
2031			$5,356,396	$5,356,396	27	$1,362,849	$2,349,031
2032			$5,490,306	$5,490,306	28	$1,327,871	$2,335,361
2033			$5,627,564	$5,627,564	29	$1,293,791	$2,321,770
2034			$5,768,253	$5,768,253	30	$1,260,585	$2,308,258
2035			$5,912,459	$5,912,459	31	$1,228,232	$2,294,825
2036			$6,060,271	$6,060,271	32	$1,196,708	$2,281,470
2037			$6,211,778	$6,211,778	33	$1,165,994	$2,268,193
2038			$6,367,072	$6,367,072	34	$1,136,069	$2,254,993
Total	$0	$28,842,631	$136,596,301	$165,438,932		$75,730,102	$100,036,618

Attachment C-5
Present Value of Soil Vapor Extraction Systems Based on Average Escalated Historical Costs
Site-Wide RA Cost Estimate
Omega Chemical Superfund Site, CA

Year	Land Costs	Escalated Capital Cost	Escalated O&M cost	Total Annual Outlays (B+C+D)	Discounting Period	Present Value (Discount Rate=5.2%)	Present Value (Discount Rate=3.1%)
2003	$0	$0	$0	$0	0	$0	$0
2004		$0	$0	$0	0	$0	$0
2005		$0	$0	$0	1	$0	$0
2006		$0	$0	$0	2	$0	$0
2007		$2,606,251	$0	$2,606,251	3	$2,238,561	$2,378,155
2008			$0	$0	4	$0	$0
2009			$646,214	$646,214	5	$501,531	$554,732
2010			$662,521	$662,521	6	$488,771	$551,630
2011			$679,239	$679,239	7	$476,335	$548,545
Total	$0	$2,606,251	$1,987,974	$4,594,224		$3,705,198	$4,033,061

Discount Rates
1994 to 2003 3-year T-Bill Average
0.052
2003 3-year T-Bill Rate
0.031